Approved by:		
	General Manager	Radiation Safety Officer

STANDARD OPERATING PROCEDURE

15.OPS.15

AIR MONITORING FOR RADIOACTIVE MATERIALS

1.0 OBJECTIVE

To define the methods and requirements for conducting air particulate and radon monitoring at the Clean Harbors Deer Trail (CHDT) facility or other job sites

2.0 SCOPE

This standard operating procedure (SOP) applies to the performance of general area and breathing zone air monitoring for airborne radioactive materials, and to radon monitoring during normal operations at the CHDT facility.

3.0 POLICY

Air monitoring will be performed to assess potential environmental impacts from site operations, to verify the effectiveness of engineered contamination control or containment systems, and to evaluate worker and public exposures from site operations. All worker and public exposures will be maintained as low as reasonably achievable (ALARA).

4.0 RESPONSIBILITIES

Responsibilities of the CHDT Radiation Safety Officer (RSO), management, and staff are defined in the CHDT Radiation Protection Plan (SOP 15.RPP.01).

5.0 AIR MONITORING PROCEDURES

5.1 General Area Air Monitoring

5.1.1 Monitoring Locations and Equipment

Meteorological study has determined the prevailing wind speeds and directions at CHDT. Continuous particulate air monitoring will be performed at three general locations at the facility. Location A is the north or downwind background air sampling station, located at some distance to the northeast of the current active disposal cell. Location B is the south or upwind background air sampling station, located south of the current active disposal cell. Locations C and D are side by side locations adjacent to the north rim of the current active disposal cell. The current airborne sampling systems consist of a Hi-Q model VS23-1023CV ¾ HP oil-less rotary vane pump, flow rate rotometer and calibration knob, elapsed timer, 47 mm diameter filter holder with 3/8 inch quick disconnect, stainless steel gooseneck to set sample point approximately 59 inches above ground, rain and wind shield, outdoor instrument weather house.

Flow rates on the air samplers are recorded from the rotometer. Flow rates are checked against the data shown by a Hi-Q Air Flow Calibrator (AFC) Complete-6. The AFC measures the true flow rate in actual and in standard temperature and pressure (STP) units. Flow calibration will

be performed a minimum of once per month, per Section 5.1.5. Upgrades or changes to the sampling equipment will be made by the CHDT RSO as needed in consultation with CDPHE.

5.1.2 Sample Collection

Air sample pumps will be run during daylight hours during sample collection periods. Samples will be collected from each location after a time period designated by the RSO that adequately samples air during representative work activity and allows sufficient sample loading to analyze. The pumps will be inspected a minimum of weekly during the sample collection to verify that the pumps are in working order. The date and time of the pump inspection and pump flow rate will be recorded in the air monitoring logbook or attached example form (Attachment 1) to document the inspection.

When filters are collected, appropriate precautions will be taken to minimize the potential for cross-contamination of samples and equipment. Nitrile or latex gloves will be worn when handling the filters and pumps. The final flow rate, elapsed time, and filter collection date and time will be recorded in a dedicated log book or on the example form included as Attachment 2.

5.1.3 On-Site Sample Analysis

Sample filters will be collected after the designated sampling period as directed by the CHDT RSO. Following a minimum decay period of 21 days, the filters will be counted onsite using the Ludlum 3030 Alpha Beta sample counter. The air activity concentration is calculated using the following equation from NUREG-1400, *Air Sampling in the Workplace* (NRC 1993).

$$C = \frac{R_n}{EFKT_S}$$

Where C = concentration of radioactive material in the air in µCi/cm^3 (or µCi/ml)

R_n = net count rate in counts per minute (cpm)

E = fractional filter efficiency (% efficiency/100)

F = airflow rate through the sampler in ml/min

K = counting efficiency in cpm/µCi

T_S = duration of sample collection, in minutes

As the 3030 accounts for detection efficiency and background and reports measurements in units of dpm, the gross alpha and beta measurements will be converted from the dpm displayed by the 3030 to a concentration of µCi/ml using the following equation.

$$C = \frac{M}{EF_{CFM}\left(\frac{ml}{3.53\times10^{-5}\ ft^3}\right)T_S\left(2.22\times10^6\ \frac{dpm}{\mu Ci}\right)}$$

Where M is the 3030 measurement in dpm. The airflow rate also requires conversion from the rotometer units of cubic feet per minute (CFM) to milliliters, as shown in the equation.

When on-site measurements are conducted, the date and time of the analysis, the counting time, and the instrument and serial number are to be recorded in a dedicated logbook or on the example form included as Attachment 3.

5.1.4 Off-Site Sample Analysis

Filters will then be sent to an offsite analytical laboratory for the following analyses:

- Gross Alpha/Beta with a desired detection limit of 2 pCi/g of sample
- Radium-226 by wet chemistry method E903.0, with a desired detection limit of 0.1 pCi/g.
- Isotopic thorium (Th-232, Th-230, Th-228) with a detection limit of 1 pCi/g of sample
- Isotopic uranium (U-238, U-235, U-234) with a detection limit of 1 pCi/g of sample

If multiple filters are collected from a single location over a month, the filters will be composited for offsite analysis.

5.1.5 Pump Calibration and Maintenance

Flow rates on the Hi-Q sampling pumps will be checked once a month during the filter change out, using the AFC-Complete-6. During calibration, the following procedure will be followed:

- Screw the sample holder with a filter into the calibration connector, connect via the hose to the AFC and the sampler inlet
- Prior to starting the flow, turn on the AFC and turn the knob to allow it to zero itself with no flow
- Plug in the pump and start the airflow
- Record the following information:
  - Date/time
  - Flow measured by the rotometer on the pump (CFM)
  - Flow measured by AFC (CFM) for both STP and actual settings
- Stop the flow and disconnect the calibrator

As necessary, the pump rotometer may be adjusted to match the AFC measurement for STP. Alternatively, values recorded from the AFC unit may be used to calculate the correct flow rate on the pump.

Maintenance will be performed as necessary on the pumps. Rebuild kits will be kept on hand at the facility. Pump maintenance will be documented in the air monitoring log book.

5.2 Breathing Zone Air Monitoring

5.2.1 Monitoring Procedures and Equipment

Breathing zone monitoring will be performed as directed by the CHDT RSO or designee to determine exposures of specific personnel to airborne radioactivity in the current active landfill,

in the treatment building and at other work-zone locations as designated by the RSO. Monitoring will be performed with portable lapel air samplers and 37 mm filters with cartridges placed near the breathing zone of the air monitoring subject. The samplers may also be placed in specific areas, or in cabs of equipment, in order to obtain a longer sample. Other types of air sampling equipment may be used such as semi-portable hi flow or low flow sampling stations, and or direct reading air samplers.

5.2.2 Sample Collection

Samples will be collected over a period of time determined by the RSO that adequately represents work activities and that collects sufficient sample for analysis. At a minimum, the following information will be collected in the air monitoring logbook or form:

- Sampled individual/activity/area
- Start date/time, and starting flow rate (including units)
- Stop date/time, and ending flow rate (including units)
- Total sampling time
- Calibration information, including pre- and post- sampling flow rate check, if performed.

When filters are collected, appropriate precautions will be taken to minimize the potential for cross-contamination of samples and equipment. Nitrile or latex gloves will be worn when handling the filters and pumps.

5.2.3 On-Site Sample Analysis

Air filters may be counted on-site using the 3030 counter, and converted to an activity concentration in µCi/ml using the following equation from Section 5.1.3:

$$C = \frac{M}{EF_{lpm}\left(1000\frac{ml}{l}\right)T_S\left(2.22\times10^6\,\frac{dpm}{\mu Ci}\right)}$$

Where *M* is the 3030 measurement in dpm. The airflow rate also requires conversion from the standard lapel sampler units of liters per minute (lpm) to milliliters, as shown in the equation.

5.2.4 Off-Site Sample Analysis

Personal air samples will be sent off-site for radiochemical analysis when determined to be required by the CHDT RSO or designee. If off-site analytical is required one or more of the following analyses may be performed:

- Gross Alpha/Beta with a desired detection limit of 2 pCi/g of sample
- Radium-226 by wet chemistry method E903.0, with a desired detection limit of 0.1 pCi/g.
- Isotopic thorium (Th-232, Th-230, Th-228) with a detection limit of 1 pCi/g of sample

- Isotopic uranium (U-238, U-235, U-234) with a detection limit of 1 pCi/g of sample

5.2.5 Pump Calibration and Maintenance

Pump calibration and maintenance will be performed in accordance with manufacturer's recommendations and the user's manual for the equipment. Where possible, the air sampler will be calibrated on-site, but calibration by a rental vendor is acceptable. In addition, battery life will be extended by following the user manual recommendations for charging.

5.3 Radon Monitoring

5.3.1 Monitoring Equipment

Radon monitoring will be performed at the CHDT facility using Landauer Radtrak alpha-track radon monitors. The Radtrak is a passive radon gas monitor that records the alpha tracks from radon gas decay. The tracks are counted and correlated with a known air concentration of radon, which is averaged over the sampling time.

5.3.2 Deployment Procedure

The radon monitors will be deployed at the following locations:

1	Active Landfill Cell
2	Active Landfill Cell
3	Treatment Building
4	Treatment building
5	South Air Sampler (Sampler B) (Background)
6	North Air Sampler (Background)
7	Perimeter Fence Background
8	Perimeter Fence (Background)
9	Perimeter Fence (Background)
10	Perimeter Fence (Background)

The Radtrak detectors will be positioned upside down inside the plastic cup. The serial numbers of the outgoing and incoming detectors will be recorded, as will the deployment date and time. Detectors will be changed out at the start of each quarter, or as close as possible – January 1, April 1, July 1, and October 1. When removed, the foil stickers provided by Landauer will be placed over the openings on the detector face.

Locations 1 through 4 will be used in estimating inhalation dose. Locations 5 through 10 are considered to be background radon locations.

5.3.3 Off-Site Analysis

Detectors will be sent to Landauer for analysis. The manufacturer's report of analysis will be sent to CHDT for review. The report will include the detector number/location, exposure in picocuries per liter (pCi/l)-days, and the average radon concentration in pCi/l.

6.0 STANDARDS AND CRITERIA

6.1 Ambient Air Sampling

Analytical results from the monthly ambient air samples will be used to estimate the committed effective dose equivalent (CEDE) estimates for site workers, per 15.RPP.05, *Estimation of Inhalation Dose.*

6.2 Breathing Zone Air Sampling

Results from breathing zone air sampling will be compared with the derived air concentration (DAC) or air effluent limits from 10 CFR 20 to determine potential worker exposure and dose.

6.3 Radon Sampling

The quarterly analytical report of measured radon concentrations will be evaluated by the CHDT RSO. Background radon levels will be statistically evaluated in order to determine average and peak natural radon levels. Radon effluent levels in the open landfill cell(s) will be compared with background levels in order to evaluate the effectiveness of the interim cover and to ensure that worker protection is adequate. If excessive levels are encountered, the landfill operations will be reviewed and modified, as appropriate, to limit radon effluents. Radon effluent levels in the treatment building will be evaluated to ensure that worker protection is adequate.

7.0 REFERENCES

10 CFR 20. *Standards for Protection Against Radiation*. Current Version.

49 CFR 173. *Shippers – General Requirements for Shipments and Packagings*. Current Version.

ANSI/HPS 1999. Surface and Volume Radioactivity Standards for Clearance.

NRC 1993. *Air Sampling in the Workplace.* NUREG-1400. September.

Ludlum Measurements, Inc., Instruction Manual Model 3030 Alpha Beta Sample Counter Meter, Current Version.

8.0 ATTACHMENTS

Attachment 1 Air Monitor Weekly Inspection Checklist

Attachment 2 Monthly Air Monitor Filter Collection Form

Attachment 3 Monthly Air Filter Counting Form